

THE FAMILY ACTEONIDAE (OPISTHOBRANCHIA, GASTROPODA) IN NEW ZEALAND

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Plate 19

SUMMARY

The New Zealand species of the genus *Pupa* are discussed. The radula of *Pupa kirki* (Hutton, 1873), a New Zealand species, is described and compared with those of *Pupa sulcata* (Gmelin, 1791) and *Pupa suturalis* (A. Adams, 1854) collected from Fiji and Queensland respectively. A new genus, *Maxacteon*, is erected for *Acteon cratericulatus* Hedley, 1906 and two new species are also described. The shells of two probable new species are described but not named.

INTRODUCTION

During a study of the biology of the bullomorph opisthobranchs many specimens of acteonid opisthobranchs were collected. The most commonly found species in Northern New Zealand is *Pupa kirki*, which shows a wide variation of colour pattern, columellar design and of spiral sculpture. My investigations also throw considerable doubt on the validity of the species *Pupa alba*.

A thorough examination of the anatomy of *Acteon cratericulatus* Hedley, 1906 and two closely related new species, has shown that a new genus must be created for this group of species.

Shells of two other undescribed species of the Acteonidae were seen but, because anatomical information is not available, it is impossible to satisfactorily place these species in an appropriate genus. Although these shells are illustrated, I have refrained from naming them.

TAXONOMY

Genus *Pupa* Roeding, 1798

Type species: *Pupa grisebia* Roeding (= *Bulla solidula* Linné, 1758) designated by Suter, 1913.
Synonymy: see Habe, 1955.

Shell thick, solid, ovate, transversely sulcate; spire elevated, acute; aperture longitudinal, narrow and basally rounded; inner lip thickened, callous; columella with large double fold, with or without an upper thin single plait.

Animal with large headshield, with a deep median slit separating shield into two posteriorly projecting lobes. Radula formula usually 5-6.0.5-6. Teeth having large base bearing long recurved denticulate flange arising from outer side. Posteriorly projecting, pointed flange being longer in outer than inner rows and inner rows usually bearing more denticles. Operculate.

Pupa kirki (Hutton, 1873)

Pl. 19, A - C; Fig. 1B, 2A

Synonymy: *Buccinulus kirki* Hutton, 1873.*Buccinulus gracilis* Kirk, 1882.*Pupa affinis* (A. Adams); Suter, 1913 (in part not of Adams).*Pupa kirki* Finlay, 1927.

The shell is well described by Suter (1913:519) as *Pupa affinis*. A large series of shells studied by the author shows that the colour is extremely variable even within one population. The three specimens illustrated show a range from the Bay of Islands, where specimens differ from pure white to those tessellated with black markings. The brown spiral lines, often present in varying degrees, are caused by pigments associated with the periostracum, whereas the black pigment lies within the calcareous part of the shell.

The spiral sculpturing of the shell is variable; some specimens are only grooved at the extremities of the body whorl while others are regularly sculptured. Similarly, in some specimens, a thin upper plait is present above the bifid columellar fold (Pl. 19, B).

The radula is constant in form. Radulae from over fifty specimens, ranging in size, colour and sculpture were examined. The radular formula is 5.0.5. The teeth consist of a large basal plate with an inwardly recurving denticulate flange. On the inner two teeth the flange is about the size of the basal plate and projects posteriorly as a pointed spine over the preceding row of teeth. Five or six large denticles extend from the outer base of the spine.

On the outer three teeth the posterior spine is much longer, extending back over two or three rows of radular teeth. The denticles at the base of the spine are smaller and decrease in number from the third to fifth tooth. The radular teeth of *Pupa sulcata* and *P. suturalis*, from Fiji and Queensland respectively, are illustrated. The radulae of *Pupa solidula* and *Pupa strigosa* Gould, 1859 are very similar and are illustrated by Habe (Habe, 1950).

Pupa alba (Hutton, 1873)

The original description, which was without an illustration, is most inadequate.

"Ovate, whorls seven, rather deeply equidistantly spirally grooved, and lightly transversely striated; columella with a broad double anterior fold, and a smaller posterior one. White. Length, .35; breadth, .15."

No locality was mentioned but in a subsequent publication it is given as "Auckland" (Hutton, 1880).

This description is totally inadequate and would fit a number of species. Suter (1913) presents a fuller description of the shell but as he notes that the type was lost it is impossible to know whether his specimen was in fact Hutton's species. Finlay (1927) chose a neotype on the following grounds: "For the small *Acteon*-like form common in northern deep-water dredgings, Hutton's *Buccinulus albus* is suitable; the type is lost, but there is only one small New Zealand species, and sufficient data is given in Hutton's diagnosis and measurements to indicate that he des-

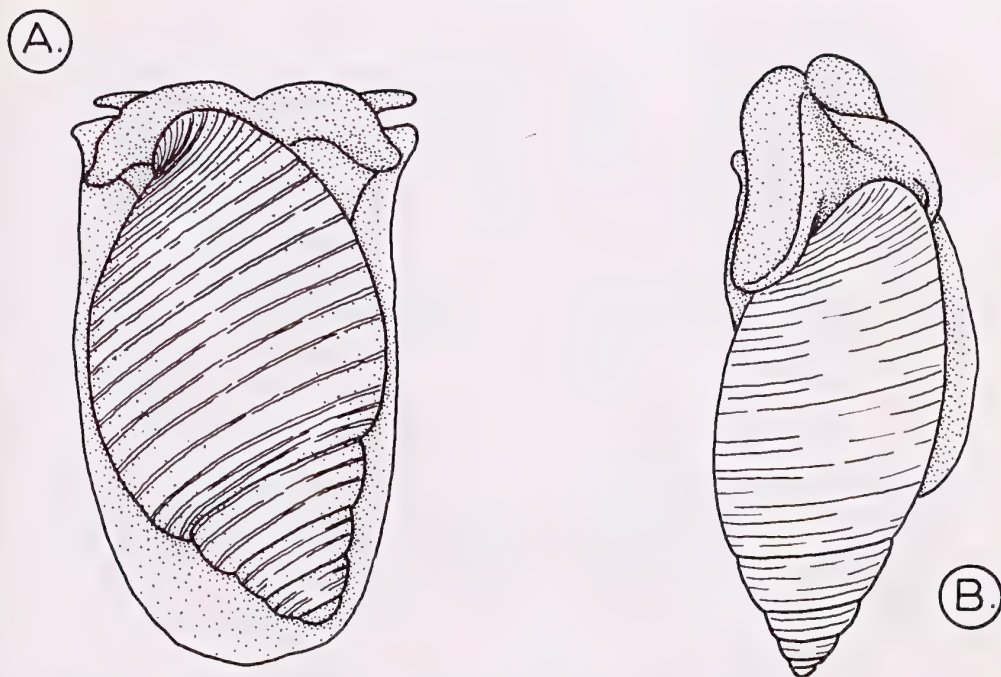


Fig. 1. A, *Maxacteon hancocki* n. sp.; B, *Pupa kirki* (Hutton).

cribed this; as the shell occurs all round the Hauraki Gulf and its precincts, and it is advisable to have a type specimen, I chose as neotype a specimen in the Finlay collection, dredged in the Hauraki Gulf in 25 fathoms."

Neither Suter nor Finlay had seen the type specimen and, as opposed to Finlay, I consider Hutton's description to be quite inadequate. These grounds alone are sufficient to have *Pupa alba* (Hutton, 1873) declared a *nomen nudum*.

Furthermore, a study of specimens labelled *Pupa alba* in private collections and the Dominion Museum, Wellington, indicates that the name has been used as a convenient label for dead deep water specimens of *Pupa kirki*. Specimens of *Pupa kirki* dredged in over 30 fathoms off the entrance to the Bay of Islands show similar shell characters to *Pupa alba* as characterised by Finlay and Suter, but are identical in anatomical and radular features to *Pupa kirki* from shallower water. It would seem therefore that those shells usually identified as *P. alba* are in fact deep water *Pupa kirki*, empty and without a periostracum. The most satisfactory course to follow, therefore, will be to submit to the International Commission on Zoological Nomenclature a request that the taxon *Buccinulus albus* Hutton, 1873 be declared a *nomen nudum*.

Genus *Maxacteon* n. gen.

Type species: *Maxacteon hancocki* n.sp.

Shell oval, more inflated than *Pupa*, aperture longitudinal, more open than *Pupa*, columella truncate bearing single fold, inner lip forming thin

callous; spire conical, less than half length of shell. Sculpture consists of regular spiral punctate grooves.

Radula of thirteen or less lateral teeth in each half row. No central tooth. Teeth consist of large basal plate with incurved posteriorly pointing flange, extending into pointed spine. Usually one or two denticles extending from the outer base of the spine.

Animal having headshield bearing a large pair of posteriorly projected fleshy lobes and a small pair of laterally projecting anterior extensions. Foot extending slightly behind the spire of shell. Operculate.

This genus is named after Mr Max Hancock of Whangarei, whose dredging activities from his keeler "Olwen" provided me with much of the material from the Bay of Islands.

Maxacteon hancocki n.sp.

Pl. 19, E - F; Fig. 1A, 2D.

Shell white with orange brown periostracal markings at base and on spire, inflated; spire half height of body whorl; aperture open, upper lip joining halfway up body whorl, basal lip rounded. Columella bearing single fold; inner lip forming slight callous. Sculptured with regular, deeply punctate, spiral grooves. Shell moderately thin. Height not exceeding 6 mm.

Animal as for genus.

Radula formula 8.0.8. Inner two teeth on each side having large basal plate and a large incurving flange bearing one large denticle at the base of a short thick posteriorly projecting spine. The next three teeth have a progressively stouter and longer posterior spine and two basal denticles. The outer three teeth become progressively smaller, the posterior spine becoming shorter and the outer tooth has only one denticle. The outermost tooth has a longer spine than the innermost tooth but is otherwise smaller. Operculum as for *Maxacteon cratericulatus*.

TYPE MATERIAL: Holotype: a shell measuring 6 mm x 3.2 mm, deposited at the Dominion Museum, Wellington, Reference No. M. 24085. Paratypes: six other shells, Reference No. M. 24086. All specimens were collected from 67 m, west of Deep Water Cove at the entrance to the Bay of Islands, March 15th, 1969.

REMARKS: This species is named after Mr M. Hancock of Whangarei who dredged the first specimens. This species is compared with the others in the final discussion.

Maxacteon cratericulatus (Hedley, 1906)

Pl. 19, G; Fig. 2F.

Synonymy: *Acteon cratericulatus* Hedley, 1906.

Acteon cratericulatus Murdoch and Suter, 1906.

As Finlay (1927) has observed, Hedley inadvertently gave a valid name to this species two months before Murdoch & Suter published their description. A full description of the shell was given by Murdoch & Suter (1906) and was repeated later (Suter, 1913). The salient points of the

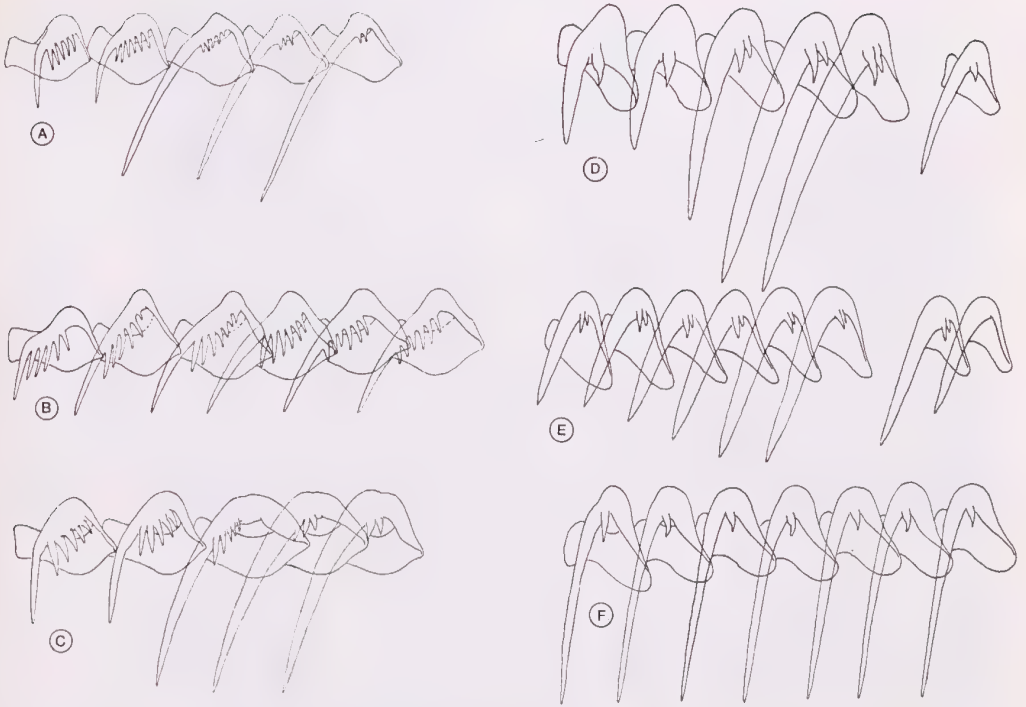


Fig. 2. Radulae. A, *Pupa kirki* (Hutton), 5.0.5; B, *Pupa sulcata* (Gmelin), 6.0.6; C, *Pupa suturalis* (A. Adams), 5.0.5; D, *Maxacteon hancocki* n. sp., 8.0.8; E, *Maxacteon milleri* n. sp. 13.0.13; F, *Maxacteon cratericulatus* (Hedley), 11.0.11.

shell of this species are: Sculpture; numerous narrow, deep punctate spiral grooves; Colour: purple tinge on shell often present on the body whorl, with a clear white region just below the suture, periostracum brown. The shell is less inflated than *M. hancocki* and the other new species, and approaches *Pupa kirki* in general outline. Columella bears a light fold.

Radula formula 11.0.11. Teeth being all of the same shape, having a large basal plate and an incurving flange extended into a long slender posteriorly projecting spine. Each tooth bears a single denticle at base of spine. All the teeth are of similar size except for the outermost which are slightly smaller.

The alimentary canal and operculum have been described (Rudman, 1971).

REMARKS: Only two preserved animals were available for study. One was dredged off Port Fitzroy, Gt. Barrier Is. and the other from the entrance to the Firth of Thames.

Maxacteon milleri n.sp

Pl. 19, I - K; Fig. 2E.

Shell white, with diffuse orange-brown axial markings; inflated, spire depressed, less than one third of the height of body whorl. Sculpture of

widely spaced broad punctate grooves; columella thin with single spiral fold. Aperture wide.

Animals as for genus. Radula formula 13.0.13. Teeth having large basal plate with recurved flange extended posteriorly into thick pointed spine. In all but the outermost tooth a pair of denticles extend out at base of spine. Spine increases in length along the row from inner tooth to the sixth, then decreases in size to outermost tooth. Outermost tooth bears no denticles at base of spine. Operculum as for *M. cratericulatus*.

TYPE MATERIAL: Holotype: shell measuring 11 mm x 7 mm is deposited in the Dominion Museum, Wellington, Reference No. M. 24087. The holotype was dredged in 54 m off Cape Brett, Bay of Islands, 8 February, 1970.

REMARKS: This species is quite distinct from any other recorded from either the recent or fossil fauna of New Zealand. Another live specimen of this species was recently collected at the Poor Knight's Islands off the east coast of Northland. *Maxacteon milleri* is named after Dr M. C. Miller of the Zoology Department, University of Auckland, in recognition of his interest and assistance in this work.

Maxacteon ? sp.

Pl. 19, D.

One shell, collected by Mr R. Grace off Ti Point, at the entrance to Whangateau Harbour, north of Auckland, in 3.6 m of water, March 1967, is quite unlike any described species.

Shell inflated, spire high, whorls shouldered, covered with brown periostracum. Sculptured with regularly spaced, narrow, punctate, spiral grooves. Columella bearing single fold.

Animal unknown.

REMARKS: This specimen has been deposited in the Dominion Museum, Wellington, Reference No. M.24088. It is 16 mm in length and 10 mm in width. I consider it unwise to name this species until the animal is available and the radula, at least, examined. The placing of this species in a genus can be no more than provisional, but it is most probably a new species of *Maxacteon*.

Acteon ? sp.

Pl. 19, H

A number of specimens of this small pink species were made available by Mrs D. Greene of Napier. They were washed up at the Mahia Peninsula, Hawke Bay in May 1968.

Shell small, narrow, pink with white subsutural band. Sculpture consisting of widely spaced punctate grooves. Shell solid with polished appearance. Columella with single spiral fold.

REMARKS: As with the last species, this is also most probably a new species. The form of the shell is quite unlike that of *Maxacteon*. As no animals were available it is not possible to either adequately describe the species or to place it in a genus. Two shells have been deposited in the Dominion Museum, Wellington, Reference No. M. 24089.

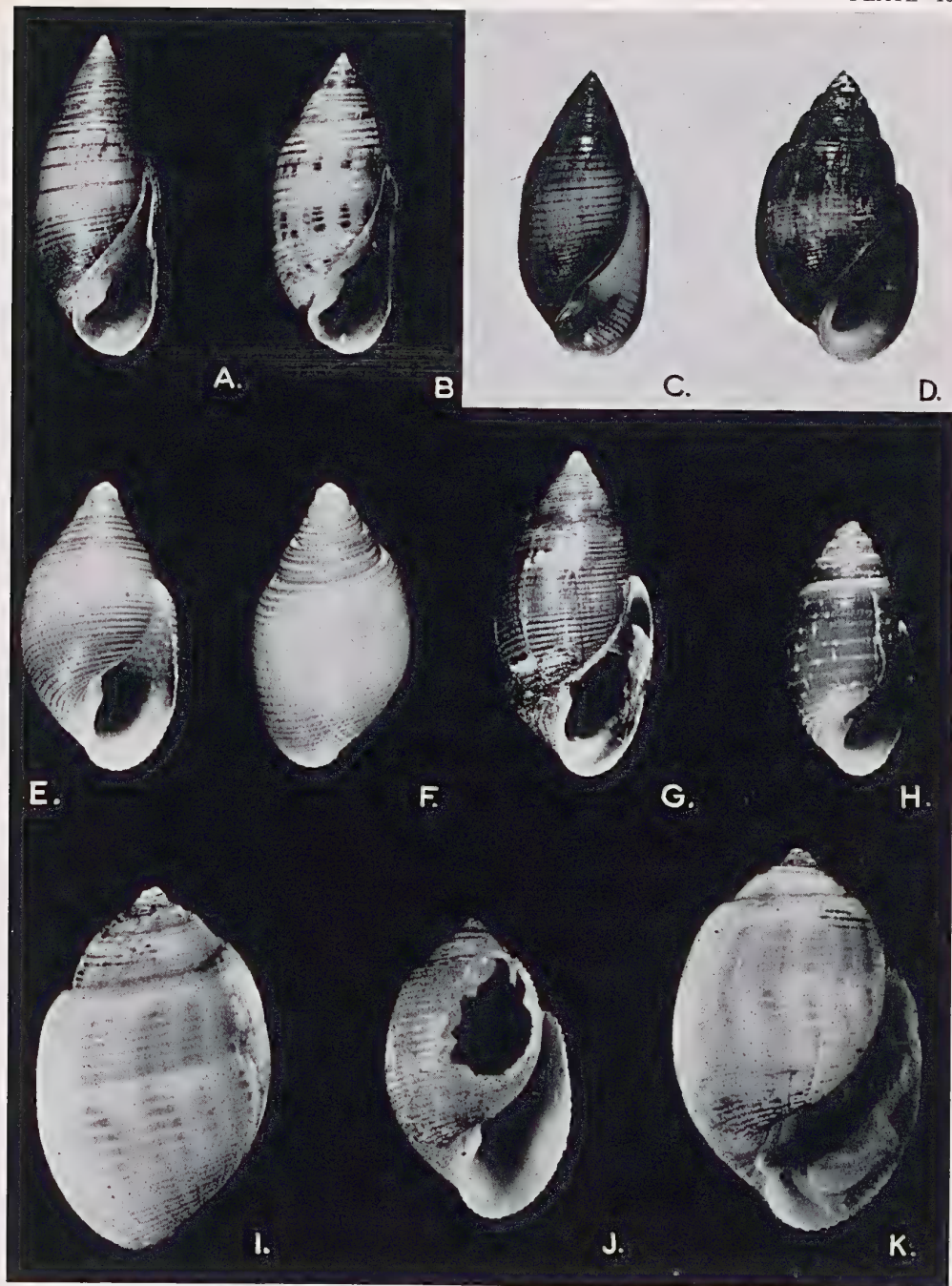


PLATE 19. A-C, *Pupa kirki*. A, white shell, with orange-brown spiral lines, Bay of Islands; 15 x 7 mm; B, white shell with black markings, Bay of Islands, 12 x 5.5 mm; C, dark orange-brown periostracum, Bay of Islands, 13 x 6 mm; D, *Maxacteon?* sp., coll. off Ti Point, Whangateau Harbour, 16 x 10 mm; E-F, *Maxacteon hancocki* n. sp., Holotype, coll. 67 m off Deep Water Cove, Bay of Islands, 6 x 3.2 mm; G, *Maxacteon cratericulatus*, coll. Port Fitzroy, Gt. Barrier Island, 17 x 8.5 mm; H, *Acteon?* sp., coll. Mahia Peninsula, Hawke Bay, 6.5 x 3.5 mm; I-K, *Maxacteon milleri* n. sp., Holotype, coll. off Cape Brett, Bay of Islands, 11 x 7 mm.

Photo — G. W. Batt.

DISCUSSION

In the Acteonidae, as in many other groups of shelled opisthobranchs, most species have been described from the shell alone. While in some cases this has proved adequate for identification, in many instances it is not sufficient.

Similarly, at the generic level adequate definitions are not available. In a study of the literature I have found over seventy species of *Acteon* and *Pupa* described from the shell alone, the distinction between the two genera being simply whether they have a bifid or a simple columellar fold. It is not surprising therefore that authors who have studied the radulae of some species have felt the need to erect new genera. In most cases, these genera have remained monotypic. The simple definition of *Pupa* and *Acteon* on the form of the columellar fold is not adequate.

The anatomy of *Acteon tornatilis* (Linné, 1766), the type species of *Acteon* Montfort, 1810, has been fully studied (Sars, 1878; Fretter, 1939; Fretter & Graham, 1954; Johannson, 1956) and it is possible to define this genus adequately. The shell is similar to *Maxacteon* in having a simple columellar fold, but the two genera differ considerably in anatomical features. The headshield, as in *Pupa*, has a pair of posterior lobes covering the extreme anterior end of the shell. The radula is quite distinct, consisting of countless minute hook-shaped teeth. Although it is not within the scope of this study, my studies of the reproductive system of the Acteonidae show that *Acteon tornatilis* has a quite different system to that of *Pupa* and *Maxacteon*.

Of the genera placed in the Acteonidae, a few have no fold on the columella, and as there is no information on their anatomy, they will not be considered in this discussion. *Pupa* alone has a bifid columellar fold. Excluding *Acteon* and *Maxacteon* the following genera have been erected for species with a simple columellar fold:

Pseudacteon Thiele, 1925, type species *P. albus* (Sowerby, 1873)

Rictaxis Dall, 1871, type species *R. punctocaelatus* (Carpenter, 1864).

Japonacteon Taki, 1956, type species *J. nipponensis* (Yamakawa, 1911).

Punctacteon Habe, 1961, type species(?) *P. fabraeus* (Crosse, 1874).

The radula of *P. albus*, illustrated by Thiele (1925), shows little difference to the illustration of Habe (1956) of *R. punctocaelatus*. The radular formula is 5.0.5. The inner three teeth have a large triangular flange, denticulate along the posterior and outer borders. In the fourth tooth the flange is more elongate and denticulate along the outer edge, while in the outer tooth the flange has become a long, non-denticulate spine. I therefore consider that *Pseudacteon* Thiele, 1925 is a probable junior synonym of *Rictaxis* Dall, 1871.

Japonacteon Taki, 1956 is the subject of a lengthy paper (Taki, 1956). In *J. nipponensis* the radular formula is 6.0.6, the inner lateral tooth consists of a large base and a small denticulate flange. The next four teeth have a large base and a long, broad, posteriorly projecting spine with two or three denticles at the base. The outermost tooth is degenerate. The headshield, unlike that of *Maxacteon*, has only a pair of large posterior lobes. The structure of the stomach and the reproductive system, as described by Taki, are greatly different to those in *Acteon*, or the other

genera of the Acteonidae that I have studied, and would suggest that *Japonacteon nipponensis* is either an extremely interesting animal or that Taki is in error.

The final genus to be considered is *Punctacteon* Habe, 1961 described in two lines, in Japanese (Habe, 1961). A subsequent English translation (Habe, 1964) shows that this description is quite inadequate. Habe simply uses this name in an entry describing the shell of *Acteon fabraeus*. This indication does not fulfil the requirements of the International Code of Zoological Nomenclature (1961) on at least two grounds. Article 13 (a) (i) states that for a name to be considered available it must be "accompanied by a statement that purports to give characters differentiating the taxon . . ." and 13 (b) "a genus-group name published after 1930 must . . . be accompanied by a definite fixation of a type-species." *Punctacteon* should therefore be declared a *nomen nudum*.

Maxacteon n.gen. is easily recognisable from other valid genera. It differs from *Pupa* in having a single columellar fold on the shell, in having lateral extensions to the headshield and in the general form of the radula. It differs from *Acteon* s.str. in the shape of the headshield, in the form of the radula and in the structure of the reproductive system. The reproductive system of the Acteonidae is to be discussed in a separate paper.

Unfortunately, as discussed earlier, the other acteonid genera with single columellar folds, are not well defined but *Maxacteon* can be distinguished by the distinctive form of the radula.

The three species of *Maxacteon* are easily separated from one another especially in regard to the shape of the shell and the radula. The shell of *M. cratericulatus* can grow to 17 mm in height and there is often a purple tinge to the body whorl of the shell, with a white subsutural band. The shell is similar to *P. kirki*, the sides of the body whorl being nearly parallel. In contrast, the shell of *M. hancocki* rarely exceeds 6 mm in height in fully mature animals, and the only colouration present is due to the orange-brown of the periostracum. The shell is slightly thinner than either of the other two species and is slightly inflated.

In the case of *M. milleri* the shell of the two specimens that have been found have been 11 and 12 mm in height and thus are much larger than *M. hancocki*. The shell is coloured with diffuse orange-brown axial markings and it is much more inflated than the other two.

As I have described earlier, the radular formulae of the three species are quite distinct. At present the geographical range of each species is distinct, but this is probably a result of the small amount of off-shore collecting that has been done in New Zealand waters. *M. cratericulatus* has only been collected in the Great Barrier Island — Firth of Thames region and *M. hancocki* only from deep-water at the entrance to the Bay of Islands. All that can be said of *M. milleri* is that one specimen has been found at the entrance to the Bay of Islands and another east of the Bay of Islands at the off-shore Poor Knights Island.

It is intended to make a formal submission on *Pupa alba* and *Punctacteon* to the International Commission on Zoological Nomenclature.

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